



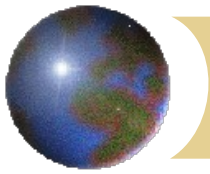
Continuous Process Improvement



Host Nation Conference
Poiana Brasov, Romania

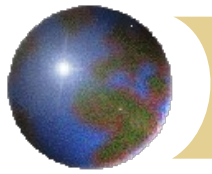
June 7, 2007

Senior Quality Assurance Specialist
Defense Contract Management Agency



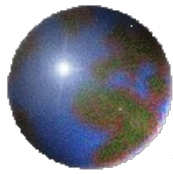
Agenda

- ✚ Introduction to Continuous Process Improvement (CPI)
- ✚ Operational Definition
- ✚ Background
- ✚ Why Implement CPI
- ✚ Overview of selected tools
 - ✚ Kaizen
 - ✚ Lean
 - ✚ Six Sigma
- ✚ Innovation
- ✚ Summary and Take Aways



Introduction - Key Points

- ✚ Having a customer focus as strategic objective
 - ✚ Understanding customers needs and wants
 - ✚ What adds value to customers product or service
- ✚ Understanding of processes
- ✚ Understanding the theory of variation
- ✚ Knowing the difference between prevention and detection
- ✚ Understanding Culture - Creating culture of CPI
 - ✚ Applies to all processes
 - ✚ Involves everyone – team work
 - ✚ Is a on-going *continuous* effort



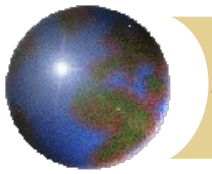
Operational Definition

Continuous Process

Improvement-

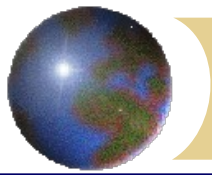
A **comprehensive** philosophy of operations that is built around the concept that there are **always** ways in which a process can be improved to better meet the needs of the **customer** so that an **organization** should **constantly** strive to make those improvements.

Source: DoD Continuous Process Improvement Transformation



Why Implement CPI?

- ⊕ Value added to customer – *in their terms*
 - ⊞ What the Customer is willing to *pay more* for
- ⊕ Can be used for all enterprise processes - not just manufacturing
- ⊕ Processes improve – variation is decreased
- ⊕ Prevention of defects rather than detection
- ⊕ Decrease in cycle times
- ⊕ Productivity increases
- ⊕ Increased reliability
- ⊕ Resource imbalances improved
- ⊕ Improved morale
- ⊕ Assists in achieving strategic goals
- ⊕ Lower costs, increased profit and market share



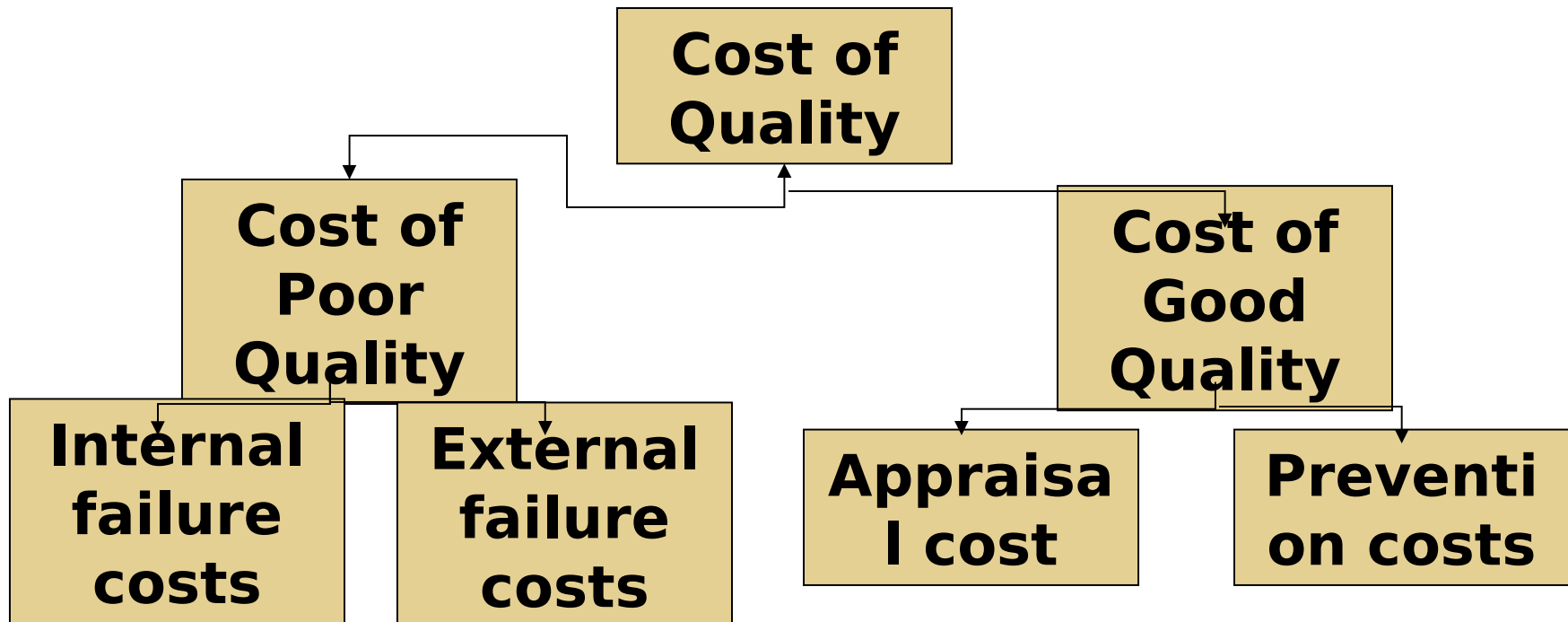
Cost of Quality (CoQ)

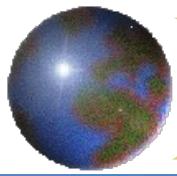
“Quality is free but it is not a gift. What costs money are the unquality things- all the actions that involve not doing jobs right the first time ”

Phil Crosby



As quality increases, Cost Decreases, therefore quality is free.



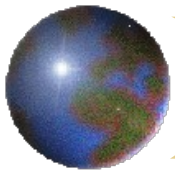


Cost of Poor Quality “The Tip of the Iceberg”

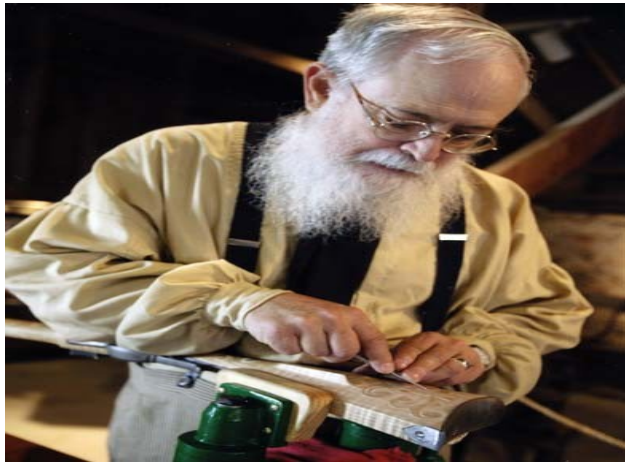
Scrap **Rework** **Repair**
Reinspection

Engineering Time Management Time **Supply Chain Disruption**
Schedule Delays **Decreased Capacity** **Decreased Readiness Levels**
Field Failures **Loss of mission** **Loss of life**
Decrease in the number units procured
Possible Loss of program

Adapted from Executive Guide to Lean
Six Sigma
Photo: Judith Currelly



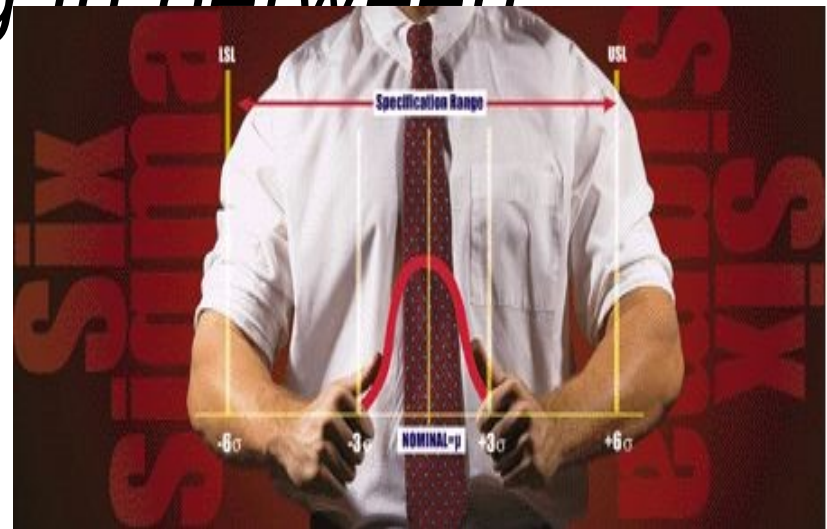
History of CPI

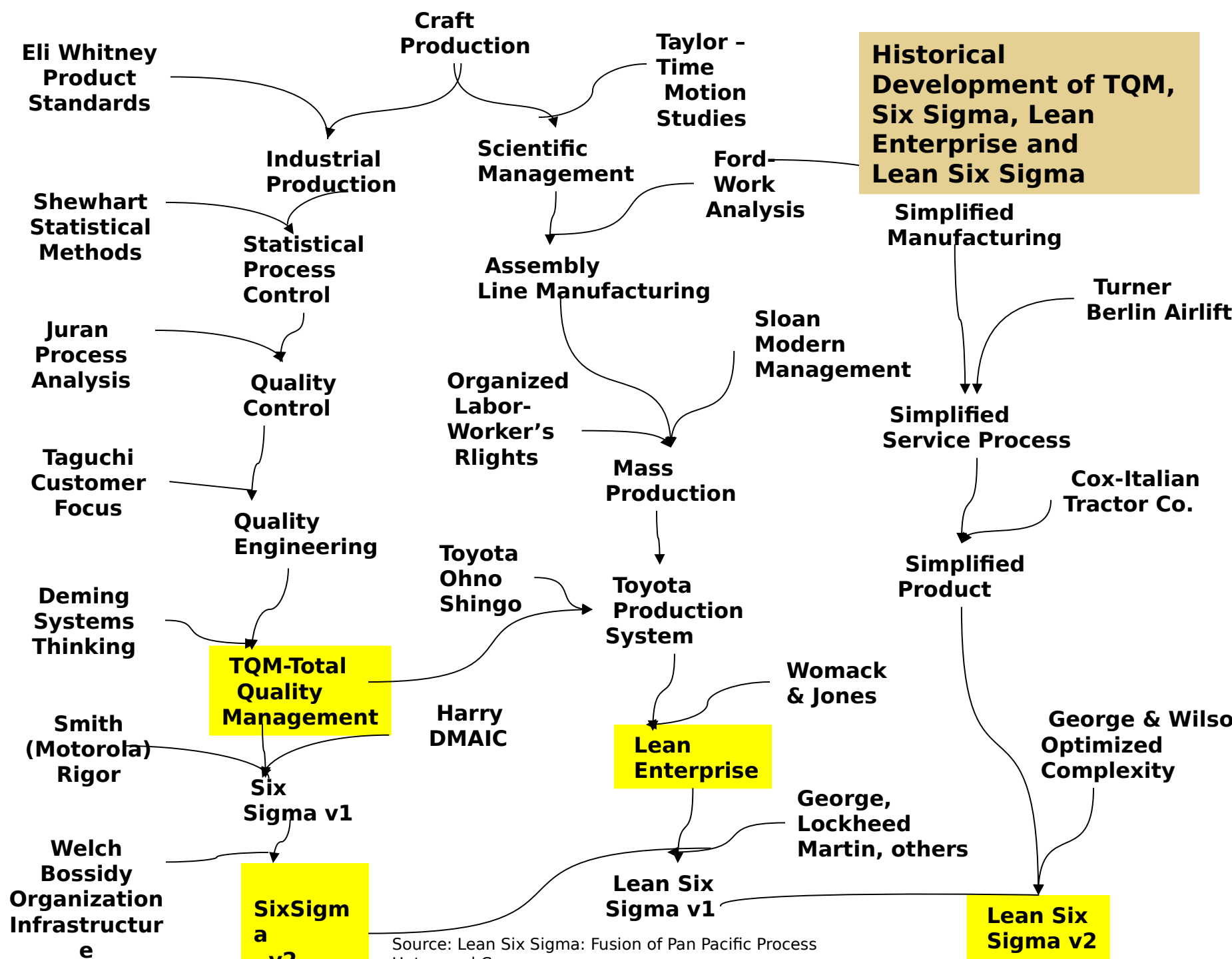


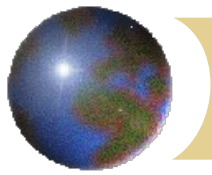
From caveat emptor

And everything in between

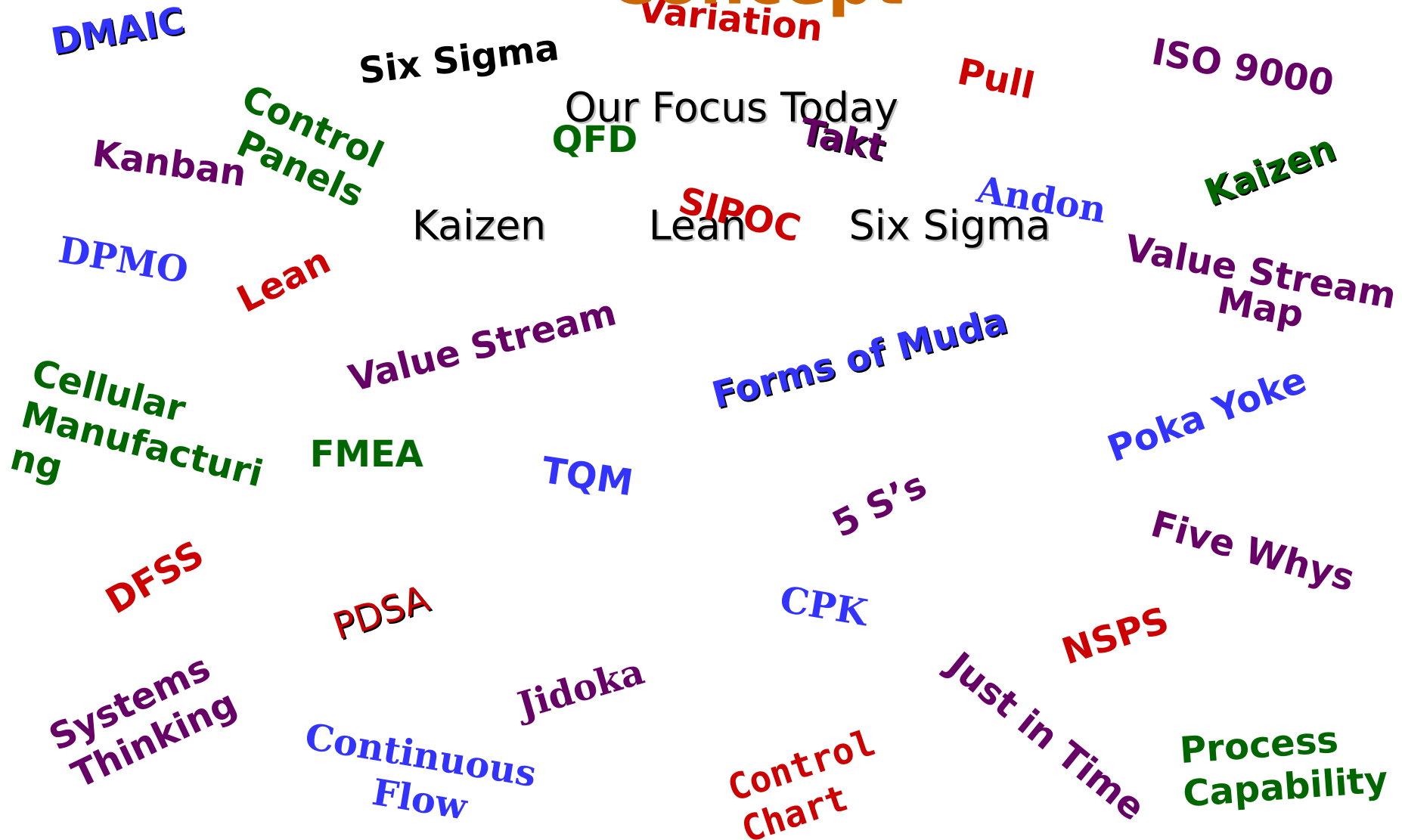
...Lean Six Sigma

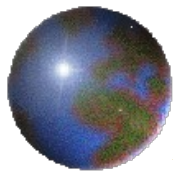






CPI - Not Just One Tool or Concept

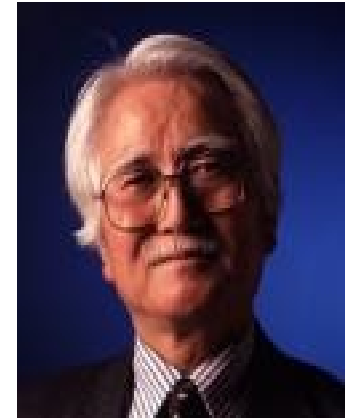




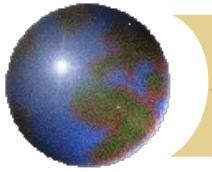
Overview of tools - Kaizen

The Kaizen philosophy assumes that our way of life—be it our working life, our social life, or our home life deserves to be constantly improved.

Maasaki Imai

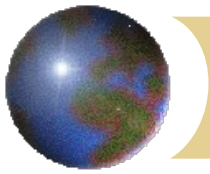


- ⊕ Japanese term – “Kai”- meaning continuous
“zen”- meaning improvement
- ⊕ Small scale continuous improvements
- ⊕ Incremental steps- addresses single problem
- ⊕ Rapid intense effort lasting 3-5 days
 - ⊠ Known as Kaizen Events, Kaizen Blitz
 - ⊠ Kaizen bursts 5-15 minutes in length
 - ⊠ DoD Rapid Improvement Event



Kaizen

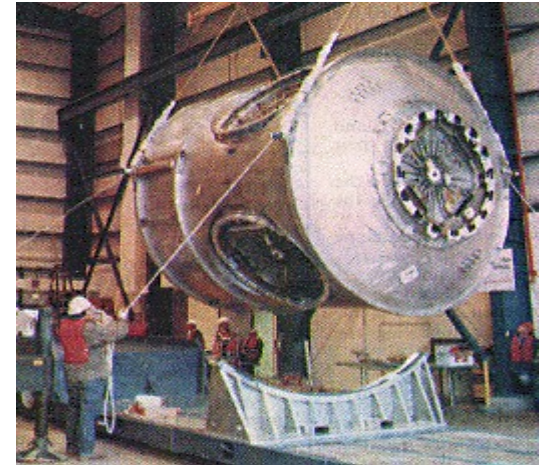
- ⊕ Involves those performing the work or directly affected by problem
- ⊕ Team participants
 - ⊞ Sponsor- management provides resources,
charter- and most important ownership
 - ⊞ 5-10 members- including team lead
 - ⊞ Wisdom of team versus knowledge of 1
- ⊕ Utilizes Gemba – go where work is performed - go and see



Kaizen

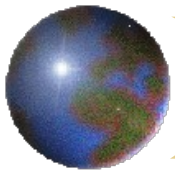
❖ Possible applications

- ❖ Bottle necks
- ❖ Defects
- ❖ Too many process steps
- ❖ Excessive handling
- ❖ Customer dissatisfaction



❖ Simple tools- require limited training

- ❖ Plan, Do, Check, Act
- ❖ Process map, data – check sheets, Pareto
- ❖ Root cause analysis – 5 whys
 - Why did machine fail? Motor burned out
 - Why did the motor burn out? Shaft seized
 - Why did the shaft seize? No lubrication
 - Why was there no lubrication? Filter was clogged
 - Why was the filter clogged? Wrong mesh size – root cause!



Kaizen

- Standardize Improvement
- Follow up
- Repeat

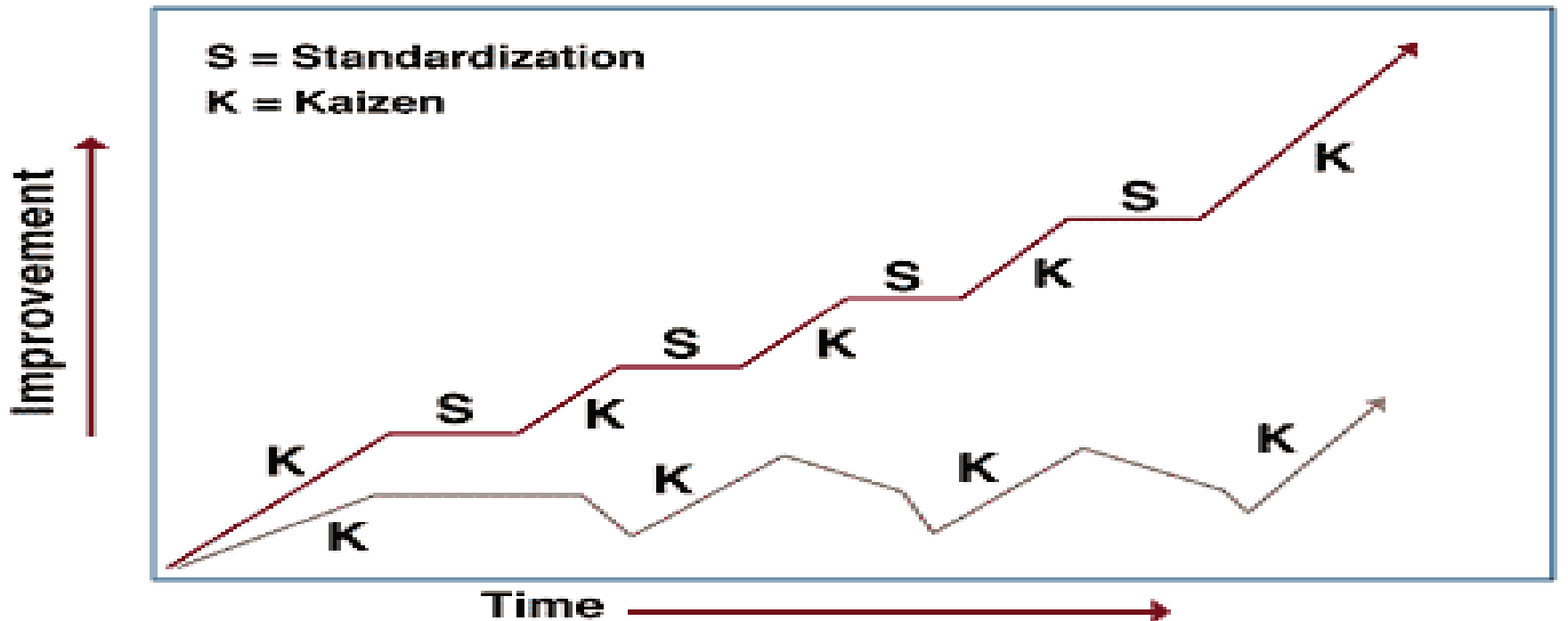
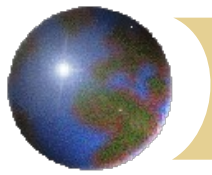


Chart Source Lockheed Martin



Overview of tools -

Lean

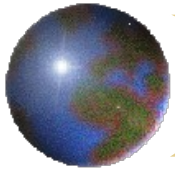
“If it doesn't add value it's waste”

Henry Ford



- ✦ **Waste** - anything that uses resources without providing value to the customer
- ✦ **Value added** - Activities that change a product or service in way customers view as important and necessary
- ✦ **Non value added NVA-** any activity that takes time, material, space, but does not add value from the customers perspective
- ✦ **Value stream-** Specific activities required to design, order, and provide a specific product or piece of information from, concept to launch- order to delivery into the hands of the customer
- ✦ **Value stream map-** identification of all the specific activities occurring along a value stream for a product or product family

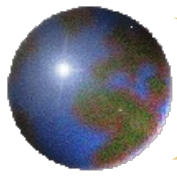
It is not uncommon to find 90 to 95% of the time consumed in a process to be NVA when considering



Lean

7 Deadly wastes + 1

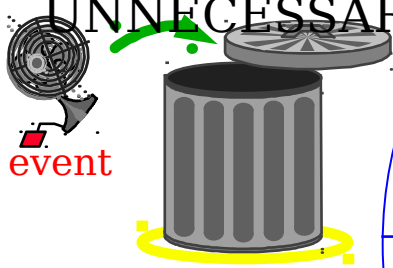
1. Overproduction
 2. Waiting
 3. Transportation
 4. Overprocessing
 5. Unnecessary inventory
 6. Excessive movement
 7. Production of defects
- + *Underutilization of employees*



Lean - Japanese 5S - Lockheed's "6S"

SERI

IDENTIFY/SEPARATE
NECESSARY FROM
UNNECESSARY



Red tag event

SORT

Clearly Distinguish
Needed Items From
Unneeded Items
And Eliminate
The Latter

SEITON

PLACEMENT/IDENTIFICATION
OF NEEDED WORK

STRAIGHTEN

Keep Needed Items
In The Correct Place
To Allow For
Easy And
Immediate
Retrieval



SAFETY

Identify
Danger And
Hazard

SUSTAIN

Maintaining
Established
Procedures

SHINE

Keep The
Workshop
Swept And
Clean

SEISON

MAINTAINING A
CLEAN WORK
PLACE

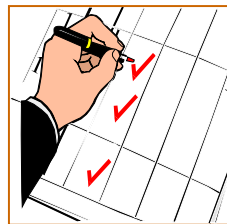


STANDARDIZE

Consistently
Applying 6S
Methods In A Uniform
And Disciplined Manner

SEIKETSU

STANDARDIZATION
FOR EASE OF USE

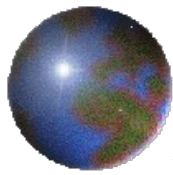


SHITSUKE

NOTATIONAL METHOD
FOR THE
CONFORMANCE TO
RULES

The 5S starts the
involvement
process
and teaches
standardization.

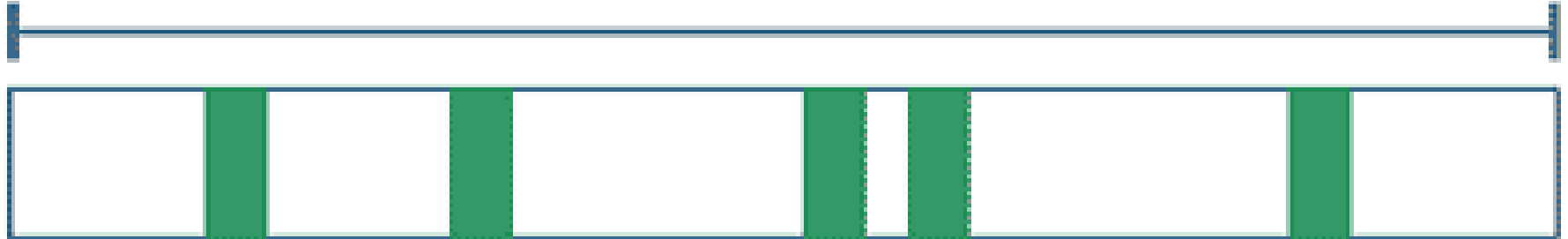
Creates visual order, visual control, transparency. (Waste will i



Lean - Managing the White Space

Receive order

Ship product



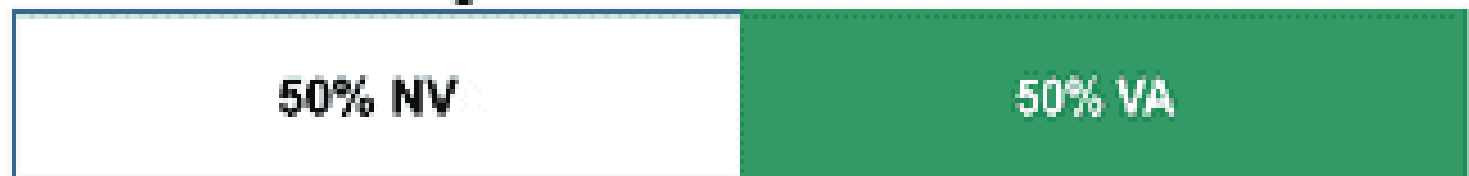
 = Value-adding operation time (stamp, weld, assemble, paint)

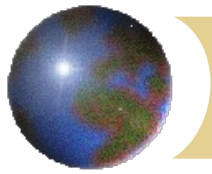
 = Non-value-adding time (receive, store, move, setup, wait, repair, rework, pack)

Value-added ratio at a typical manufacturing company



Lean Manufacturing

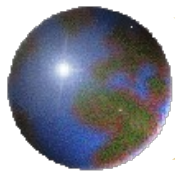




Tool Overview- Six

Sigma

- ✚ **Helps to attain Strategic Vision**
- ✚ **Philosophy- reduce variation, make customer focused data driven decisions**
- ✚ **Methodology - structured problem solving roadmap**
- ✚ **Metric (standard of measurement)**
- ✚ **Vehicle for:**
 - ▣ **Customer focus**
 - ▣ **Breakthrough improvement**
 - ▣ **Continuous improvement**
 - ▣ **People Involvement**



Lean Six Sigma: A Powerful Methodology

D

I

Define

What is important to the customer:
Project Selection

Confirm understanding w/sponsor

Team Formation

Establish Goal-

RC

**How well we are doing:
understand the causes of the problem:**

Est. baseline, process capability Construct Process Flow to observe process, Collect Data , Validate Measurement

M

C

Measure

The process:
Analyze Data, regression analysis, DOE, Identify Root Causes, Supply Chain optimal? Develop Improvement plan

A

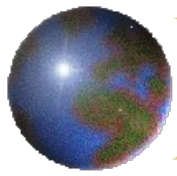
Improve

The process performance measures:

**Prioritize root causes
Innovate, pilot solutions
Validate the improvement**

Control

The process gains:
Ensure solution is sustained, document improved process, turn results into \$



Lean Six Sigma - Tools and Techniques

Define

Measure

Analyze

Improve

Control

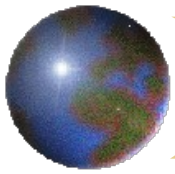
Benchmarking
FMEA
IPO Diagram
Kano's Model
Knowledge Based Mgt
Project Charter
SIPOC Model
Quality Function Deployment
Voice of Customer
Task Appraisal / Task Summary
Value Stream Mapping

Confidence Intervals
Measurement System Analysis
Nominal Group Technique
Pair wise Ranking
Physical Process Flow
Process Capability Analysis
Process Flow Diagram
Process Observation
Time Value Map
Value Stream Mapping
Waste Analysis

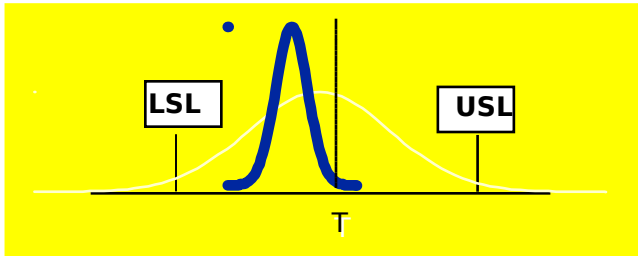
Affinity Diagram
Brainstorming
Cause & Effect Diagram
e-test
F-test
Fault Tree Analysis
FMEA
Histogram
Historical Data Analysis
Pareto Chart
Reality Tree
Regression Analysis
Scatter Diagram
t-test
5 Whys

DFSS
DOE
Kanban
Mistake Proofing
PF/CE/CNX/SOP
Standard Work
Takt Time
Theory of Constraints
Total Productive Maintenance
Visual Management
Work Cell Design
5S Workplace Organization

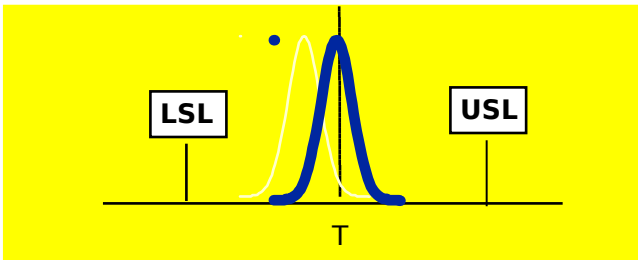
Control Charts
Control Plan
Reaction Plan
Run Charts
Standard Operating Procedures



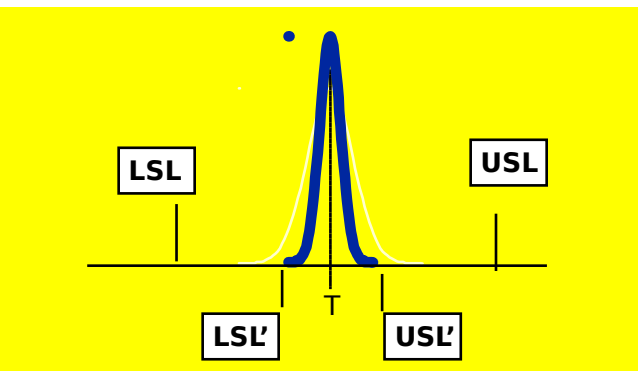
Six Sigma



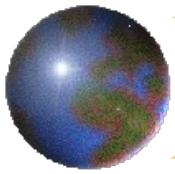
Characterize



Optimize



Breakthrough

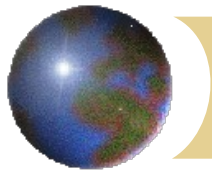


Six Sigma Metric

- ✚ 3.4 Defects Per Million Opportunities
- ✚ A very good level of quality - but how good?

Sigma Level	DPMO
2	308,770
3	66,811
4	6,210
5	233
6	3.4

Defect Levels Corresponding to Sigma Levels

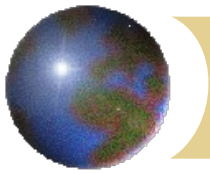


Sigma Level Comparisons

Three Sigma Quality Level	Six Sigma Quality Level
54,000 Incorrect drug prescriptions per year	3 Incorrect drug prescriptions every year
40,500 billing errors year	2 billing errors a year
No electricity, water, or heat for 2 hours a month	No electricity, water, or heat for 1 second every 2 years
Five long or short landings at Heathrow each day	One long or short landing at Heathrow every 10 years
5,400 lost articles of mail per hour	65 lost articles of mail per day

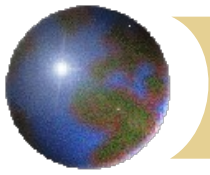
Is 99.73% Good enough for your organization?

Is 99.999660% Better?



Innovation

- ✚ Innovation is an integral component of CPI
- ✚ Everyone should be encouraged to:
 - ✚ Be creative
 - ✚ Look for ideas continually
 - ✚ Imagine uncharted territories
 - ✚ Roam around the world in your mind
 - ✚ Visualize situations
 - ✚ Handle multiple variables
 - ✚ Prioritize a combination of variables
 - Machines, materials, methods, manpower, environment
 - ✚ ***Never*** criticize



Innovation

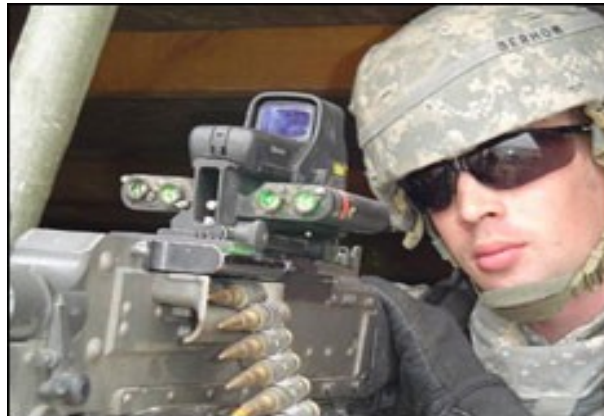
What do Bono and Tom Cruise have in

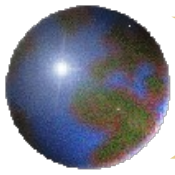


- ✦ They both look cool wearing sunglasses
- ✦ What does that have to do with the DoD?
- ✦ Number of eye injuries on the increase- 16% of casualties are attributed to eye injuries
- ✦ What was root cause? - sand, dust, debris from helicopters, smaller shrapnel fragments?
- ✦ What is typical age of soldier?
- ✦ Issued glasses were too “ugly” – FL seniors should be wearing
- ✦ Contracted with Wiley for ballistic eye protection
- ✦ More consistent use- automatic drop in injuries



- Innovative solution to critical problem
- 5 Whys is an effective tool
- Significant reduction in overall Injuries and...
- Injury severity





Innovation and CPI

What can we learn from

Formula 1?



- ✚ Both are very efficient in their pit stops- *they are LEAN*
- ✚ *8-14 seconds to change 4 tires, receive fuel, make adjustments*
- ✚ What does that have to do with the DoD?
- ✚ We are terribly inefficient in our depot and field maintenance
- ✚ Logistics footprint is huge, Sys. design needs improved



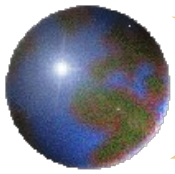
NASCAR Innovation and CPI



M1A2 being refueled

(Photo by Greg Stewart)

- ✦ **UH60 Blackhawk utilizes laminate windshield tear offs**
 - ✦ *Simple solution to tactical problem- sandy, dusty environment*
 - ✦ *Replace Mylar instead of windshield, faster , <\$, increased readiness*
- ✦ **Terminal High Altitude Area Defense (THAAD) used NASCAR's Carlson for Pit stop technology**
 - ✦ *fewer people with less training, transparency created, tools reduced from hundreds to 16 , rear cable panel moved to front panel*
 - ✦ *removal and replacement of all equipment reduced from 1/2 day to <1/2 hour*
- ✦ **M1 A1 design focused on ability to directly engage - doesn't do well keeping engaged. Reduction in maintenance and refueling time keeps tank engaged**
- ✦ **"Pit stop engineering" has been adopted by the Army**



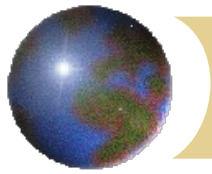
CPI Summary

“Its funny how everything begins to look like a nail when the only tool you have is a hammer”



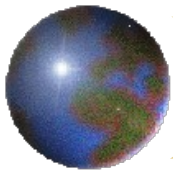
- There are many CPI tools
- We scratched the surface
- Tailor tool to your need
- You must decide what the best tool is for a particular problem





Summary Take Aways

- ✚ Having a customer focus as strategic objective
 - ✚ Understanding customers needs and wants
 - ✚ What adds value to customers product or service
- ✚ Understanding of processes
- ✚ Understanding the theory of variation
- ✚ Knowing the difference between prevention and detection
- ✚ Understanding Culture - Creating culture of CPI
 - ✚ Applies to all processes
 - ✚ Involves everyone – team work
 - ✚ Is a on-going *continuous* effort



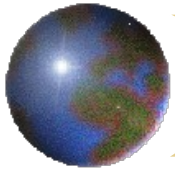
Resources



Continuous Process Improvement Transformation Guidebook

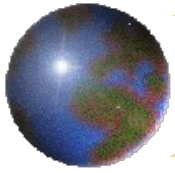
May 2006

- ❖ **American Society for Quality ASQ**
 - **Six Sigma Forum**
- ❖ **Lockheed Martin**



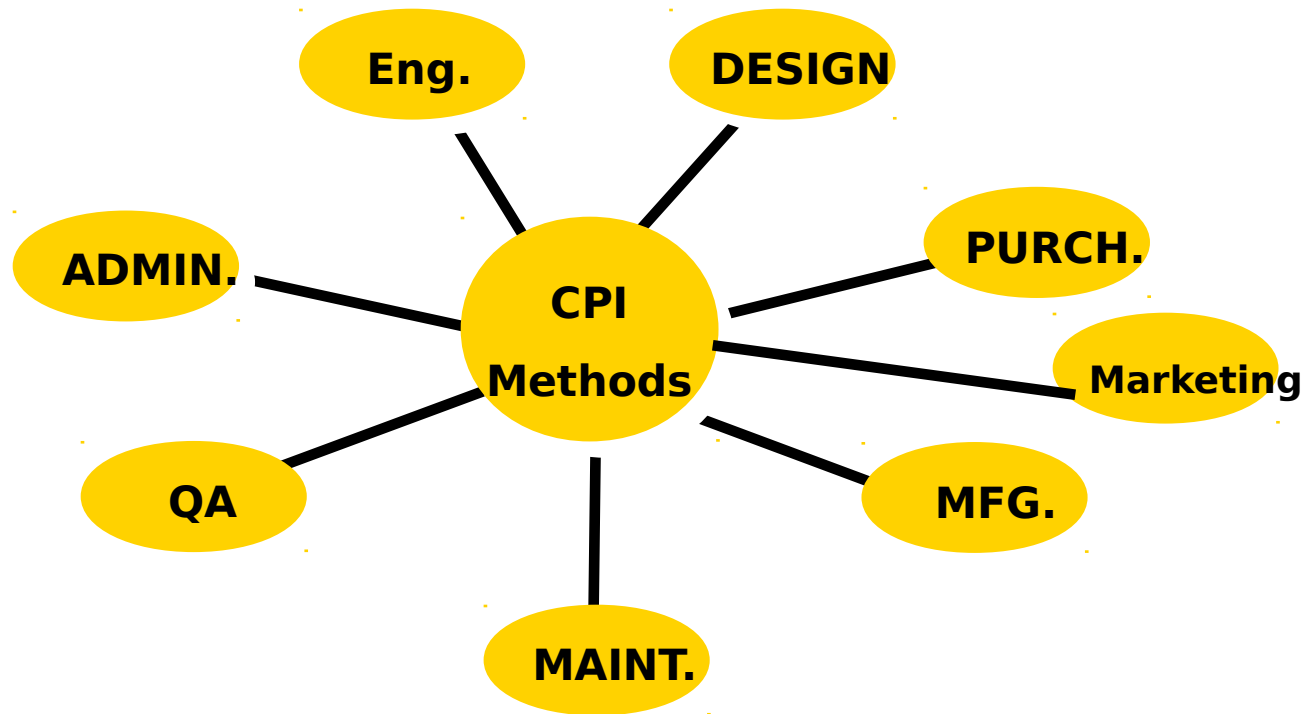
Continuous Process Improvement

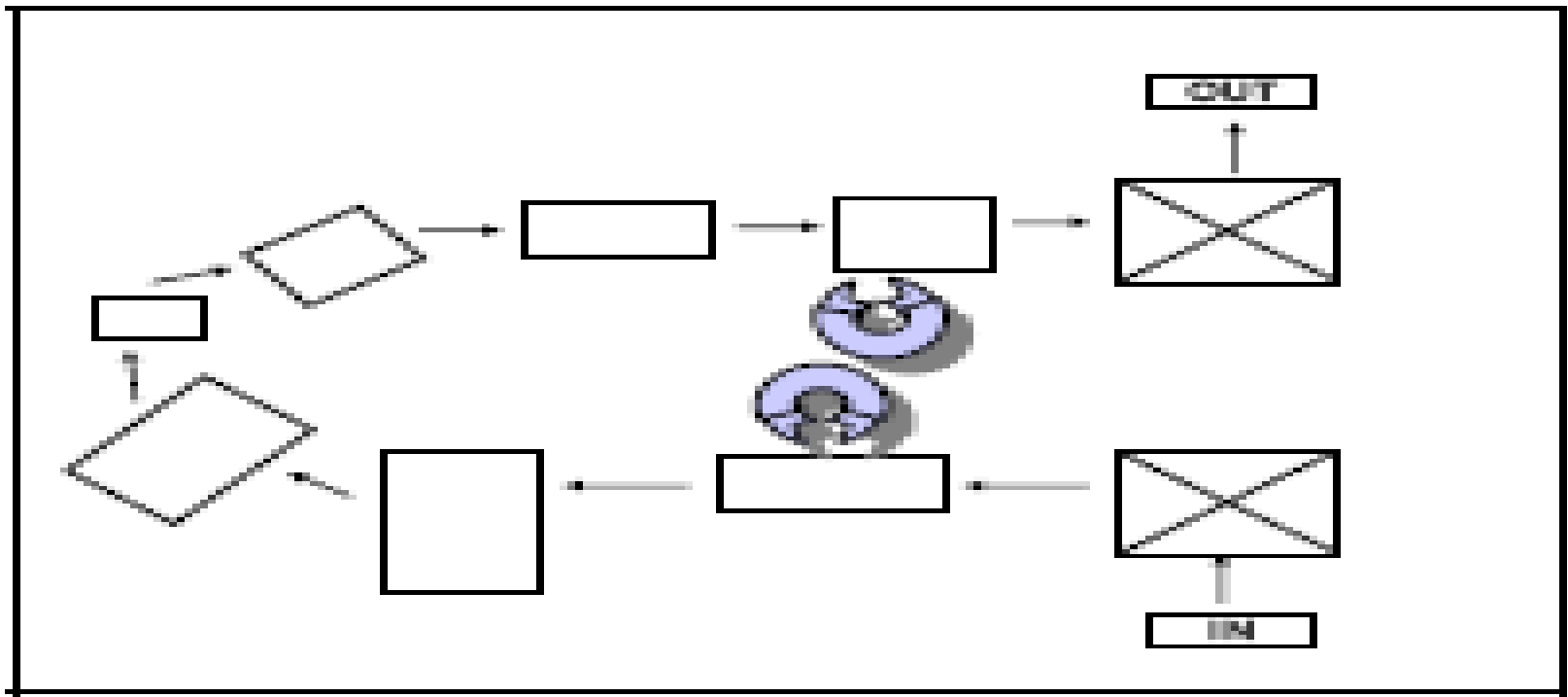
Questions?



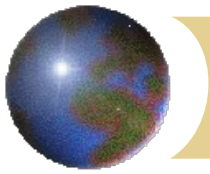
Resources

CPI Back up Material



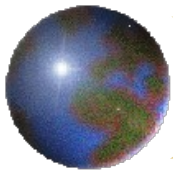


Cellular Manufacturing Flow

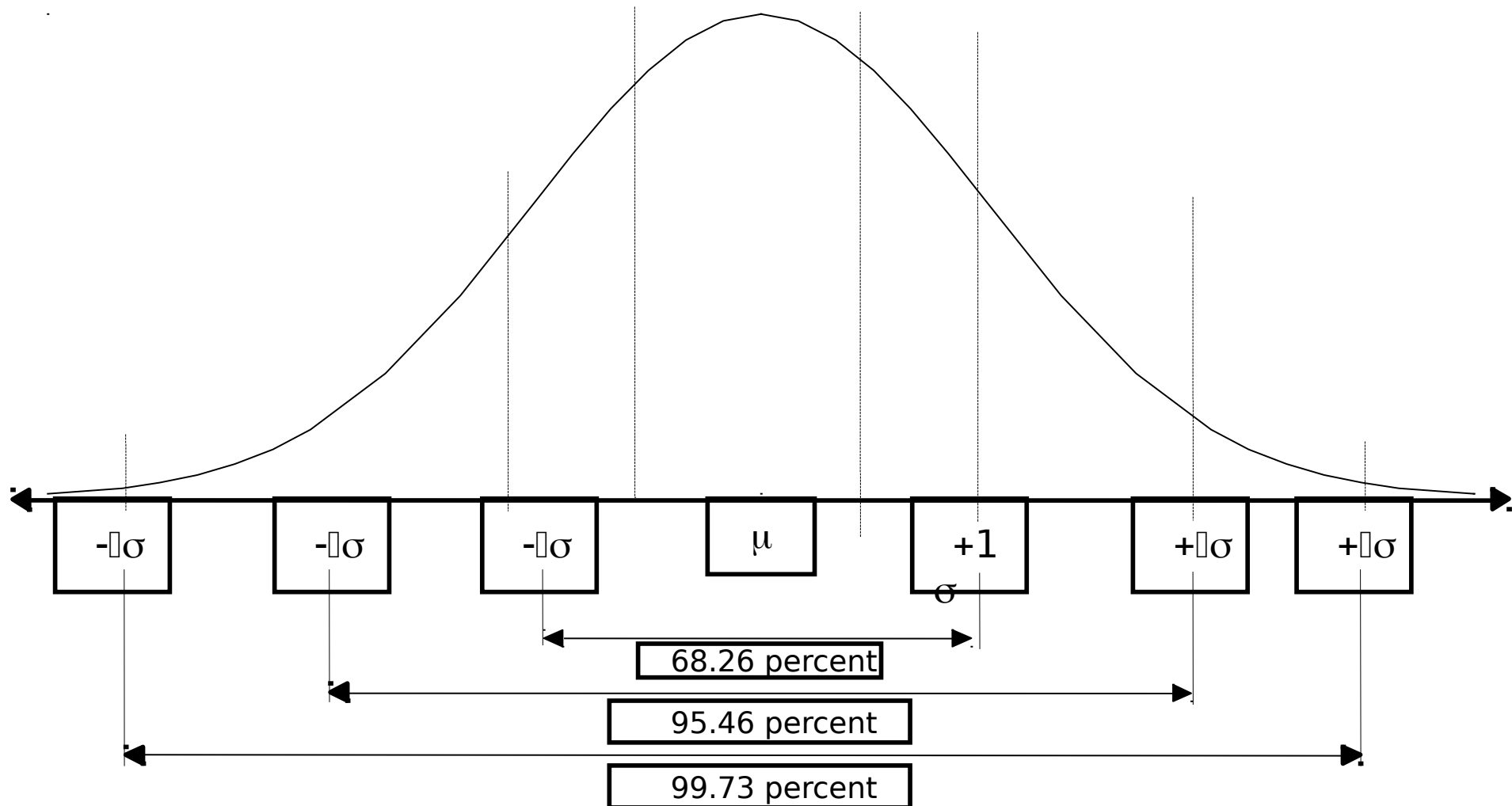


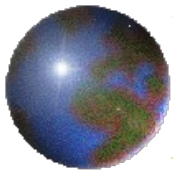
Six Sigma

- ✦ Unlike Kaizen and Lean requires significant investment, training
- ✦ Dedicated resources
- ✦ Time consuming – 2-6 Mo
- ✦ Uses sophisticated tools- reliance on statistics
- ✦ Used for toughest problems- not low hanging fruit
- ✦ Capable of breakthroughs of significant magnitude
- ✦ Improves process capability and reduces variation
- ✦ Finds the sweet spot in the process operating window

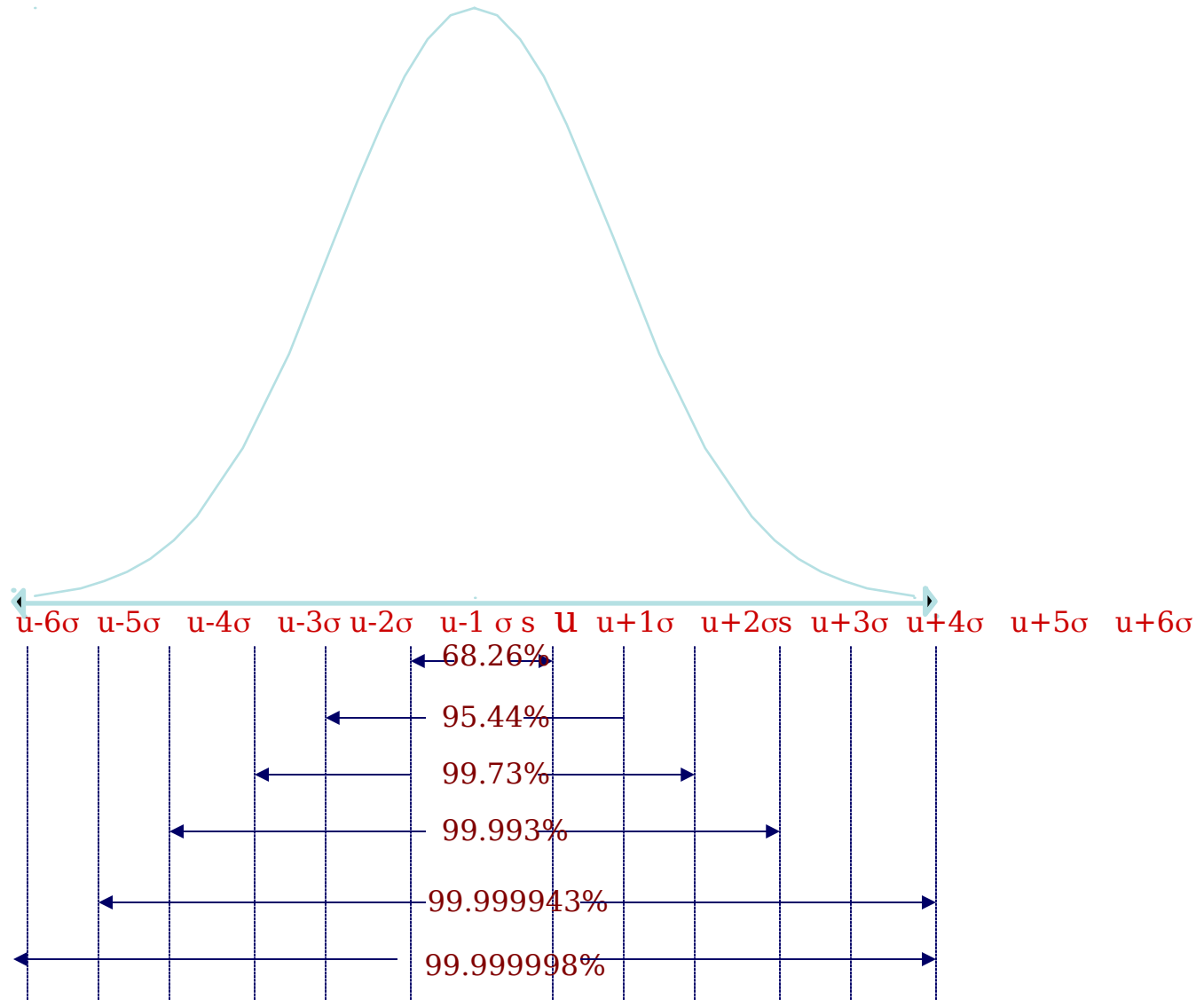


3 Sigma Process





6 Sigma Process

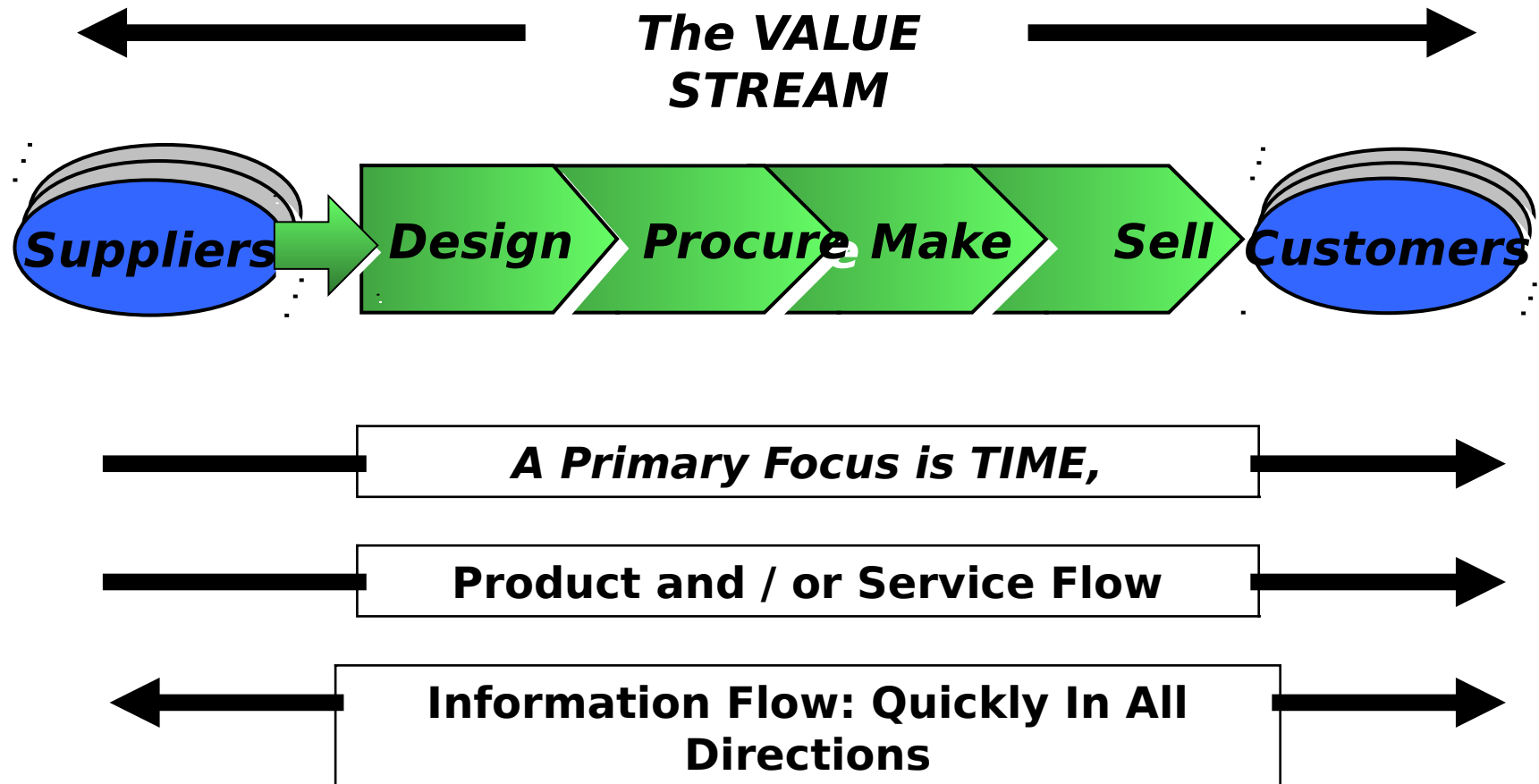


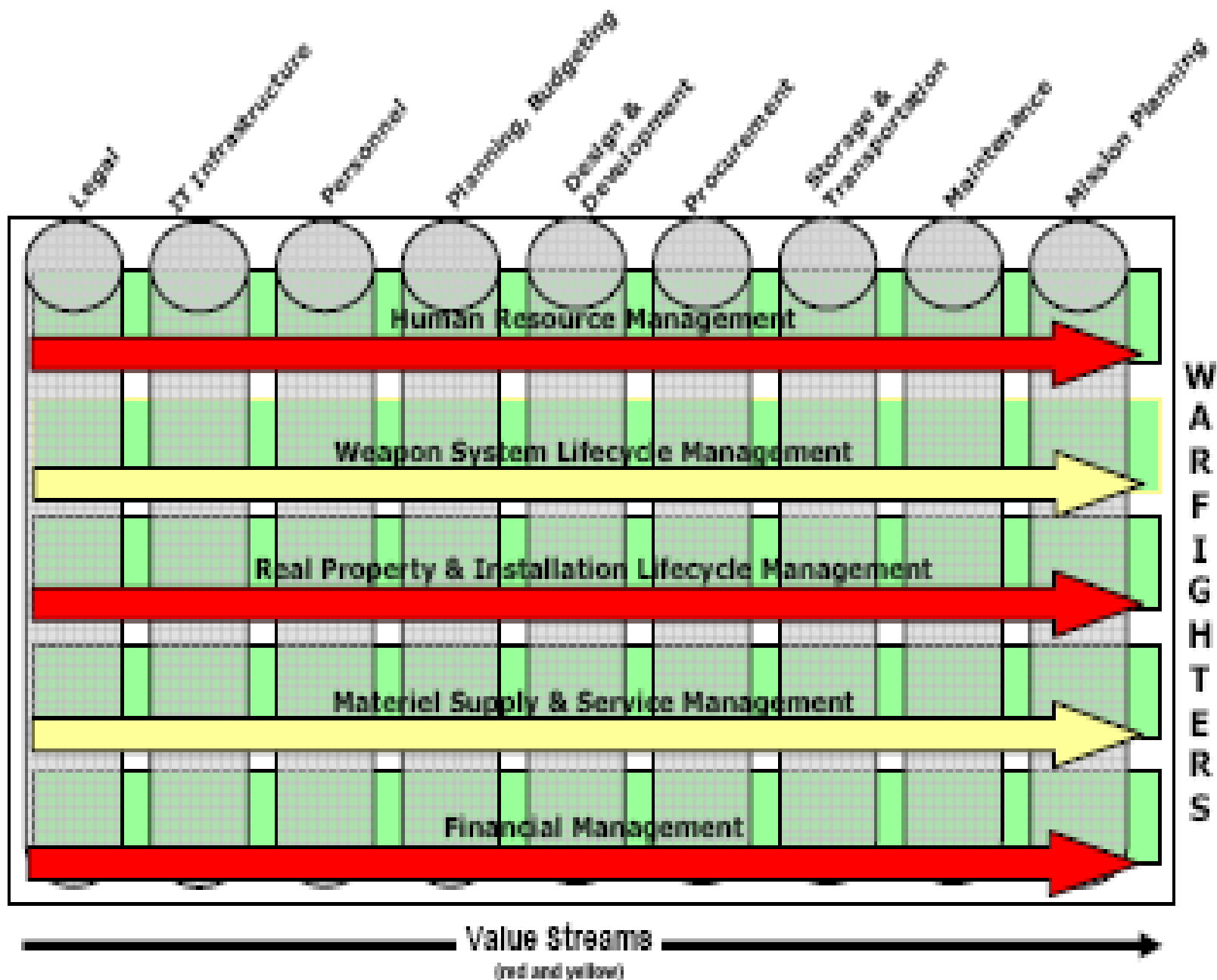


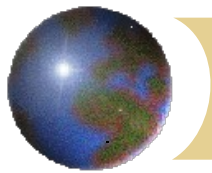
Definition of a Value

Stream

The **VALUE STREAM** is the entire set of processes or activities performed to transform the products and services into what is required by the customer.

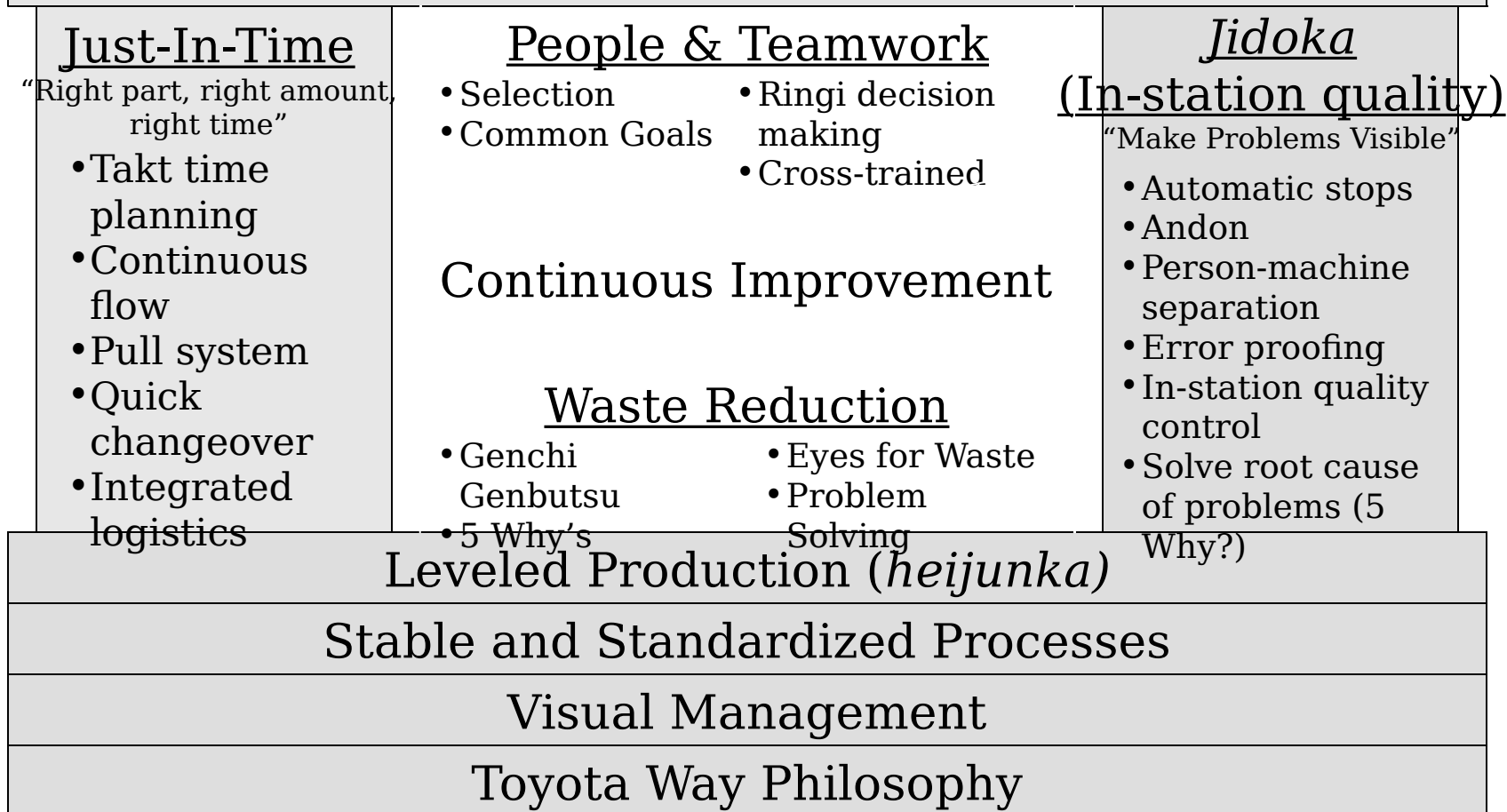






The Toyota Production System

Best Quality - Lowest Cost - Shortest Lead Time - Best Safety - High Mor
 through shortening the production flow by eliminating waste



Toyota Motor Manufacturing

MISSION

1. Add value to customers and society
2. As an American company contribute to the economic growth of the community and the United States
3. As an independent company, contribute to the stability and well-being of team members
4. As a Toyota group company, contribute to the overall growth of Toyota

Ford Motor Company

MISSION

Ford is a worldwide leader in automotive and automotive-related products and services as well as in newer industries such as aerospace, communications, and financial services.

Our mission is to improve continually our products and services to meet our customer's needs, allowing us to prosper as a business and to provide a reasonable return to our stockholders, the owners of our business.

Benefits of Early Detection

Defects Found At:

Own Processes
(Self-Verification)

Next Processes

End of Line

Final Inspection

End User's Hand

Cost to the Company



Impact to the Company

- Very Minor

- Minor Delay

- Rework
- Reschedule of Work

- Significant Rework
- Delay in Delivery
- Additional Inspection

- Warranty Cost
- Administration Cost
- Reputation
- Loss of Market

